

WHAT IS CLAIMED IS:

1. A method of manufacturing a semiconductor device, comprising:  
forming a fin structure on an insulator;  
forming a gate structure over a portion of the fin structure;  
forming a sacrificial oxide layer around the gate structure;  
replacing the gate structure within the sacrificial oxide layer with a metal gate; and  
removing the sacrificial oxide layer.
2. The method of claim 1, wherein the forming a fin structure includes:  
depositing a dielectric layer on a silicon layer, and  
etching the dielectric layer and the silicon layer to define the fin structure with a  
silicon portion and a dielectric cap.
3. The method of claim 2, further comprising:  
growing oxide layers on sides of the silicon portion.
4. The method of claim 1, wherein the forming a gate structure includes:  
depositing a gate material over the fin structure, and  
planarizing the deposited gate material.
5. The method of claim 4, wherein the depositing a gate material includes:  
depositing polysilicon over the fin structure.
6. The method of claim 4, wherein the forming a gate structure further  
includes:

depositing an antireflective coating on the planarized gate material,  
depositing a photoresist layer over the antireflective coating, and  
patterning the photoresist layer to define the gate structure.

7. The method of claim 1, wherein the forming a sacrificial oxide layer includes:

depositing a sacrificial oxide material over the gate structure, and  
polishing the sacrificial oxide material until a top surface of the sacrificial oxide material is coplanar with a top surface of the gate structure.

8. The method of claim 2, wherein the replacing the gate structure includes:

etching away the gate structure to define a recess within the sacrificial oxide layer,  
and  
removing the dielectric cap.

9. The method of claim 8, wherein the replacing the gate structure further includes:

depositing a dielectric material having a dielectric constant greater than about 3.9 over the silicon portion of the fin structure.

10. The method of claim 9, wherein the replacing the gate structure further includes:

depositing a metal in the gate recess, and  
polishing the metal to define the metal gate within the sacrificial oxide layer.

11. The method of claim 8, wherein the replacing the gate structure further includes:

thermally growing an oxide material having a dielectric constant of about 3.9 on the silicon portion of the fin structure.

12. A method of manufacturing a semiconductor device, comprising:  
forming a fin structure on an insulator;  
forming a gate structure over a channel portion of the fin structure;  
forming a sacrificial oxide layer around the gate structure;  
removing the gate structure to define a gate recess within the sacrificial oxide layer;  
forming a metal gate in the gate recess; and  
removing the sacrificial oxide layer.

13. The method of claim 12, further comprising:  
forming a dielectric layer on the fin structure in the gate recess before the forming a metal gate.

14. The method of claim 13, wherein the forming a dielectric layer includes:  
depositing a dielectric material having a dielectric constant greater than about 3.9 on the fin structure.

15. The method of claim 13, wherein the forming a dielectric layer includes:  
growing an oxide material on the fin structure.

16. The method of claim 12, wherein the forming a sacrificial oxide layer includes:  
depositing a sacrificial oxide material over the gate structure and the fin structure,  
and  
polishing the sacrificial oxide material until none of the sacrificial oxide material remains over the gate structure.

17. The method of claim 12, wherein the forming a metal gate includes:  
depositing a metal in the gate recess, and  
planarizing the metal to define the metal gate within the sacrificial oxide layer.

18. A method of manufacturing a semiconductor device, comprising:  
forming a fin structure including a dielectric cap on an insulator;  
forming a gate structure over a channel portion of the fin structure;  
forming a sacrificial oxide layer around the gate structure;  
removing the gate structure to define a gate recess within the sacrificial oxide layer;  
removing the dielectric cap on the fin structure;  
forming a dielectric layer on the fin structure;  
forming a metal gate in the gate recess within the sacrificial oxide layer; and  
removing the sacrificial oxide layer.

19. The method of claim 18, wherein the forming a dielectric layer includes:

depositing a dielectric material having a dielectric constant greater than about 3.9 on the fin structure.

20. The method of claim 18, wherein the forming the dielectric layer includes:

growing an oxide material having a dielectric constant of about 3.9 on the fin structure.